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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 22 September 2003 with an application for Letters Patent number 528396 made by ARMORFLEX LIMITED.

Dated 1 October 2004.

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PROVISIONAL SPECIFICATION

GUARDRAIL

WE Armorflex Limited, a New Zealand Company of Unit 6/25 Airborne Road, Albany, Auckland, New Zealand

do hereby declare this invention to be described in the following statement:

GUARDRAIL

TECHNICAL FIELD

This invention relates to a guardrail and in particular, though not solely, this invention relates to a guardrail for use with road networks and/or the guardrail may be utilised where vehicle road lanes require separation by a barrier.

BACKGROUND ART

Existing highway guardrail end treatment systems include: the breakaway cable terminal (BCT), the eccentric loader terminal (ELT), the modified eccentric loader terminal (MELT), the vehicle attenuating terminal (VAT), the extruder terminal (ET 2000 and ET plus), the slotted rail terminal (SRT), the sequential kinking terminal (SKT) and the flared energy absorbing terminal (FLEAT).

Terminal ends (that is, the end facing incoming traffic) generally consist of one or more, often three, W shaped guardrails supported by a series of both controlled release terminal (CRT) or frangible posts and standard highway guardrail posts. Generally a cable assembly arrangement is utilised that anchors the end of the rail to the ground, transferring tensile load developed in a side on impact by an errant vehicle to the ground anchor. Generally the terminal ends have an impact head arrangement that will be the first part impacted by an errant vehicle during an end on impact and is designed to spread or absorb some of the impact energy.

Some terminal ends such as the ET, SKT and FLEAT, absorb the energy of the impacting vehicle during an end on impact by having an impact head that slides down the W shaped guardrails, extruding it and breaking away the support posts as it travels down the rail. All other abovementioned terminal ends work on the principal of various weakening devices in the posts and rails to allow an errant

vehicle to penetrate the terminal end in a controlled manner and prevent the rails from spearing the vehicle or the vehicle from vaulting or jumping over a relatively stiff terminal end.

All the abovementioned guardrail terminal ends are all considered to be gating, that is, if impacted between the impact head and the "length of need" (where the "length of need" is considered to be the distance from the terminal end to where the guardrail will redirect a vehicle during an angled impact) during an angled impact, the terminal end will gate and allow the errant vehicle to pass to the back side of the terminal end. However this gating effect may have undesirable or unsafe results, and preferably an improved or safer or varied energy absorbing system is utilised to control errant vehicle barrier/guardrail impacts.

It is therefore an object of the present invention to provide a guardrail to go at least some way towards addressing the foregoing problems or to at least provide the industry with a useful choice.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the

listed components it directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

Accordingly, in a first aspect, the invention may broadly be said to consist in a guardrail which comprises:

a plurality of spaced apart support posts at least some of which have a predetermined failure load,

a plurality of rails slidably interconnected and mounted directly or indirectly to said posts,

at least one cable provided along at least a part of the length of said slidably interconnected rails wherein each end of said at least one cable is fixed, and,

at least one cable gripping means through which the cable is threaded and which provides resistance to cable movement therethrough.

Preferably, said at least one cable is threaded through the cable gripping means in a tortuous path.

Preferably, the path of the cable through the cable gripping means includes at least one substantially 180° turn.

Preferably, the cable configuration through the cable gripping means is substantially an S or Z-shape.

Preferably, during an impact the at least one cable is forced through the cable gripping means, where resistance to cable movement substantially facilitates impact energy dissipation.

Preferably, said at least one cable is substantially located within a recess of the plurality of slidably interconnected rails.

Preferably, the at least one cable is tensioned.

Preferably, the at least one cable is anchored to a ground anchor at at least one end.

Preferably, the end of at least one cable located furtherest from the cable gripping means is anchored to a rail and/or a support post.

Preferably, where the at least one cable is anchored to a support post without a predetermined failure load, the support post has a greater failure load than the predetermined failure load support posts.

Preferably, the slidably connected rails telescope upon an impact substantially in-line with the longitudinal direction of the slidable rails.

Preferably, the rails are separated from the support posts by a spacer.

Preferably, the cable gripping means is mounted on a first post, an impact slider device is attached to the end of a first rail distal to the cable gripping means, wherein the impact slider device is slidable along a second rail.

Preferably, the movement of the impact slider device along the second rail disconnects the second rail from its associated post or posts.

Preferably, the support posts of predetermined failure load have a substantially horizontal region of weakness.

Preferably, the cable gripping means is connected to an end of the plurality of interconnected rails.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figures 1a and 1b — illustrates a perspective view from the impact side of one embodiment of a guardrail according to the present invention; and

Figures 2a and 2b — illustrates the reverse perspective view of the embodiment of Figures 1a and 1b.

BEST MODES FOR CARRYING OUT THE INVENTION

This invention is designed to be a substantially non-gating guardrail, meaning that at any point along the side of the guardrail from the terminal end onwards, an impacting vehicle on an angled collision may be substantially redirected away from its initial impact trajectory. It is also designed to substantially absorb energy during an end on impact to the terminal end.

"Gating" is a term used within the guardrail industry to refer to sections of guardrail which are unable to withstand high impact side angle collisions, and significant guardrail deformation or ultimate failure or breakage may occur.

For the purposes of this illustrative description, Figures 1a and 1b will be referred together as Figure 1; similarly Figures 2a and 2b will be referred to as Figure 2. The guardrail 1 shown has been split into two sections for illustrative purposes only, and sections A and A' in Figures 1a and 1b; and the same sections are

labelled B and B' in Figures 2a and 2b should be joined to show an embodiment the guardrail according to the present invention.

In a first embodiment of the present invention, and with reference to Figures 1 and 2 there is provided a guardrail 1 with a cable gripping means 2 at the terminal end. The cable gripping means 2 may form part of an impact head (where an impact head is an additional guardrail bumper used to initially absorb some impact energy).

The cable gripping means 2 (and optionally impact head) may be bolted to the first rail 3, at the other end of which is connected an impact slider device 4. The impact slider device 4 may facilitate the sliding of the first rail over each subsequent rail, thereby providing substantial telescoping ability to the guardrail, with each rail overlapping the next rail to enable this process during an end-on impact. The rails 3, 5, 6 may be supported by upstanding CRT (controlled release terminal) 7a, 7b, 7c, 7d and/or frangible posts and/or posts of a predetermined failure load or any combination of these post types. The rails may be directly attached to the posts, or alternatively may be indirectly attached via a spacer 17 or similar block type arrangement.

The impact slider device 4 may also be used to detach or facilitate the disjointing or disconnection of a connection such as bolt 8 between a rail 5 and a support post 7. Preferably the impact slider device 4 is a structural member of suitable strength that allows the bolts 8 (or similar connector) connecting rail 5 to posts 7a – 7g; or rail 5 to rail 3 or the next rail 6; to either be severed from the rail or pulled or bent free from the rail connection. The rails 3, 5, 6 may be connected to each other separately from support post connections. Depending on the strength and/or impact force generate by an impact with guardrail terminal end and subsequently the slider, the bolts 8 may be made of materials such as plastics or high density

plastic or other composite materials, or frangible bolts, which are more likely to fail and be sheared off from the post connection (or from the rail to rail connection) by an impact from the slider, than a side angle impact with the guardrails. This may be an advantageous feature allowing the slider to operate and shear off post holding rail bolts 8, whilst at the same time providing resistance to side angle impacts and reducing the likelihood of the guardrail gating.

A cable 15 has an end 10 which may be attached to a soil anchor assembly or fixed such as at 11, at the terminal end of the guardrail. The other cable end 11a extends to a second anchor or fixed point 12, which may be a further soil anchor assembly, or alternatively, may be an anchoring assembly attached to a non-frangible support post or non-telescoping rail. The cable 15 may be anchored by cable brackets 13 to the posts or rails or by any suitable cable anchoring system, such as bolts and welds or the like. The soil anchor assembly arrangement may include a sunken post (or I-beam) with flares or winged portions 18 extending outwards from the post to engage with greater soil area and providing increased resistance to movement of the anchor assembly as a result of an impact with the guardrail.

The embodiment shown in Figures 1 and 2 of a guardrail system consists of a soil anchoring system 11 at the terminal end of the guardrail and provides a means to attach two cables 15, 15a thereto. The cables are preferably threaded in a substantially S-shape (or Z-shape), through the cable gripping means 2, which may be a steel plate bolted to the terminal end of a length of rail 3 (or first post 7a). At the junction of the first 3 and second 5 rails (or sections of rails), there is an impact slider device or "slider" 4 that fits over the end of the first rail 3 and into which the next rail 5 may slide.

The cables 15, 15a, after being threaded through the cable gripping means 2, are positioned in a hollow or recess 14 of the back side of the length of the rail (for example, the rail may be a W-shaped beam). The cables may extend until a point 11a where they may be anchored to the rail (or post, or other anchoring means) at a post downstream of the cable gripping means 2 using one or more cable brackets 13 or other connecting and/or cable fixing means. Such means may be screw bolts, welded joints or other suitable devices enabling substantially secure cable anchoring. The cable may be tensioned, although this is not necessary for the present invention to substantially operate.

In use, energy from a head on impact with the impact head/cable gripping means 2 is initially substantially absorbed by support post (7a), which may subsequently fail, preferably substantially at or near ground level 16. For example the first support post 7a would normally be impacted at or by the impact head/cable gripping means, and absorb energy before preferably failing (that is, being broken). Should a support post fail and be broken off at a height substantially above ground level than that would contact the impacting vehicle and then the vehicle may collide with the broken post and result in more severe impact energy absorption (possibly resulting in vehicle occupant damage due to sudden movement arrest).

Similarly, as the slider device 4, impact head/cable gripping means 2 and first rail 3 (and subsequent rails) telescope down the second rail 5, rail 3 upon rail 5, each support post is impacted by the slider device 4 and preferably causes breakaway of the posts.

Preferably, the guardrail system employs energy absorption/dissipation systems which substantially control an impacting object momentum and directional motion. For example, energy may be absorbed or dissipated by the friction between the cable 15 and cable gripping means 2. When the guardrail is impacted end on (that

is, in the substantially longitudinal direction of the guardrail and impacting the impact head and/or cable gripping means initially), the whole of rail 3, the impact head/cable gripping means 2 and the impact slider device 4 move back in a telescoping manner over rail 5 and then subsequent downstream rails, such as rail 5 and/or rail 6. Energy is also absorbed by the friction of the cables 15 running through the cable gripping means 2, wherein the threaded cable configuration through the block provides at least one substantially 180° turn. Alternatively, the cable gripping means 2 utilises a substantially S-shape cable threaded configuration, as is shown in Figures 1 and 2.

Preferably, as the cable gripping means 2 is attached to or forms an integral part of a bumper or impact head, as the impact head and cable gripping means move (as a result of an end-on impact with the impact head/guardrail), away from the cable anchor point 11, the cable gripping means is effectively forced to move along the cable(s), whilst the cable(s) 15, 15a substantially stationary as a result of being fixed at each end. In doing so, the cable is forced through a number of bending movements created by the threading configuration in the cable gripping means. Preferably, the cable used has substantial resistance to flexing (such as steel cable), and energy is dissipated from the impact and imparted to energy used to bend the cable.

Additionally, as the cable gripping means 2 moves along the cable(s) 15, the cable is forced to run in surface-to-surface contact with the cable gripping means, which preferably results in additional frictional energy dissipation. In an alternative embodiment, the cable gripping means 2 may be in the form of a sleeve fitted around the cable 15, 15a, which is snug around the cable and provides frictional resistance to relative movement of either the sleeve or cable.

In an even further preferred energy dissipation system, the friction created by the impact slider device 4 (and rails 3, 5, 6) moving over one another during an impact event may help to absorb energy.

Energy from a side angle impact with the guardrail 1 is absorbed by the flexion and/or deformation (whether by elastic or plastic deformation) of the rails, as well as by the tensile forces created in the cable(s) 15, 15a (which may help the rails to resist flexion and/or deformation). Preferably, the impacting object is redirected away from the guardrail 1 and the forces generated by the impact are distributed throughout the rails and cables either by deformation or tension generated in the cables and subsequently redirected to the cable fixing point.

Preferably, a number of support posts 7a–7g may be frangible or of a pre-determined failure load which fail or substantially deform, consequently absorbing further impact energy. Preferably an object, such as a vehicle, involved in a side angle impact is substantially redirected away from the guardrail, and back onto the road, and the guardrail itself is restrained from "gating" by the further tension created in the cables by the impacts induced lateral cable movement.

Preferably, the guardrail as described above may be utilised in applications where protective barriers are required to separate vehicle traffic flow from each other, or safety to pedestrians from vehicles, or even to protect vehicles running off roads. It is desirable that the guardrail as described provides a non-gating design and which re-directs an errant vehicle from its correct path back onto a road or at least away from pedestrians on a footpath.

The guardrail as described goes at least some way toward facilitating a system for controllably slowing a vehicle during an end-on barrier impact, as well as some way towards preventing the guardrail from gating during a side angled impact. It is also preferable that the "length of need" is substantially reduced compared to various

existing technologies, and may most preferably have a length of need of almost zero distance.

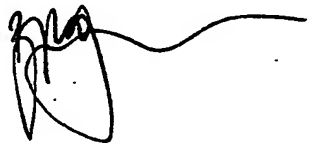
The guardrail as described may be utilised to form a part of whole of a guardrail system, although this system in particular may be applied to the terminal ends of a required guardrail or barrier or be substantially retrofitable to existing guardrails.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

ARMORFLEX LIMITED

by its Attorneys

JAMES & WELLS



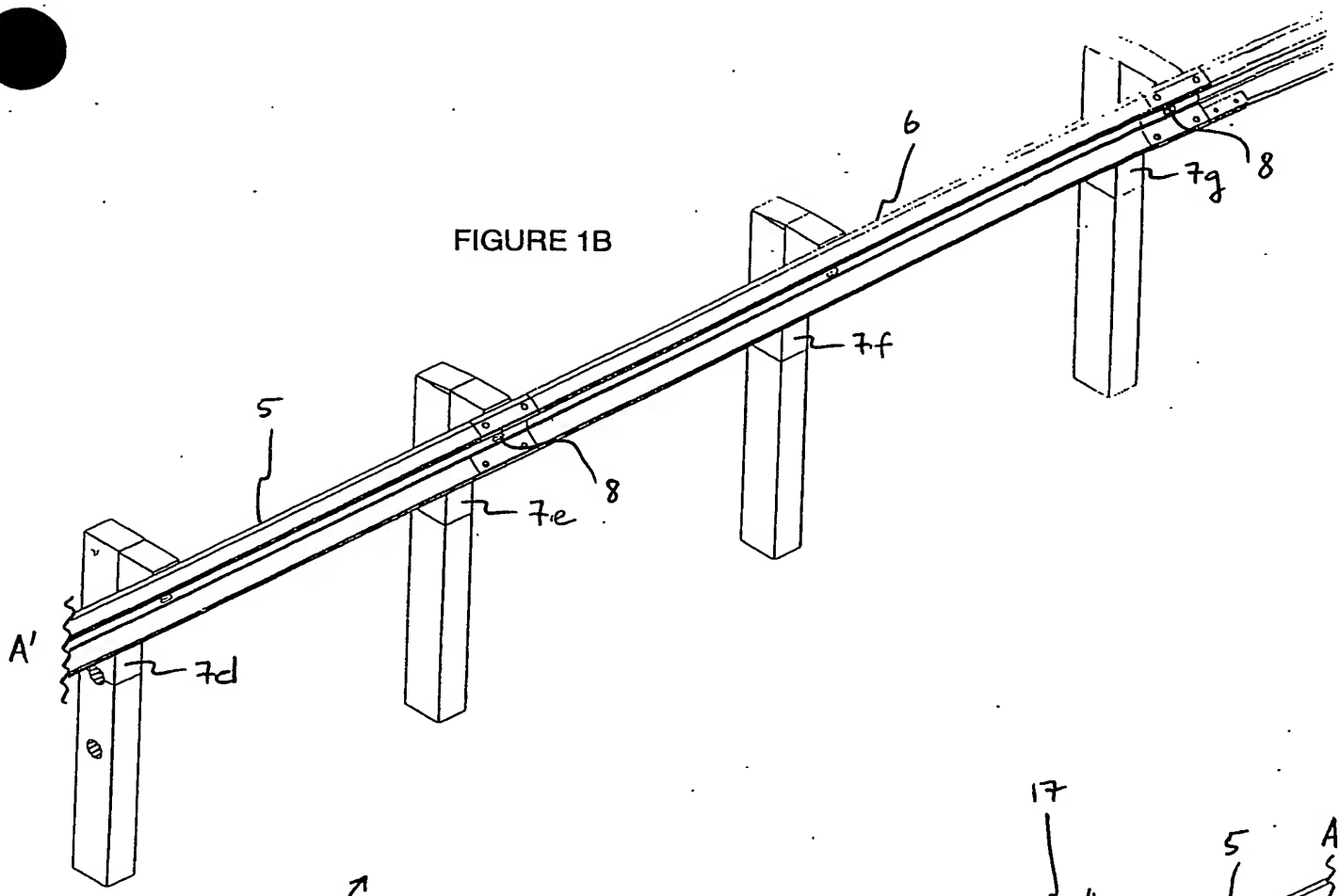


FIGURE 1B

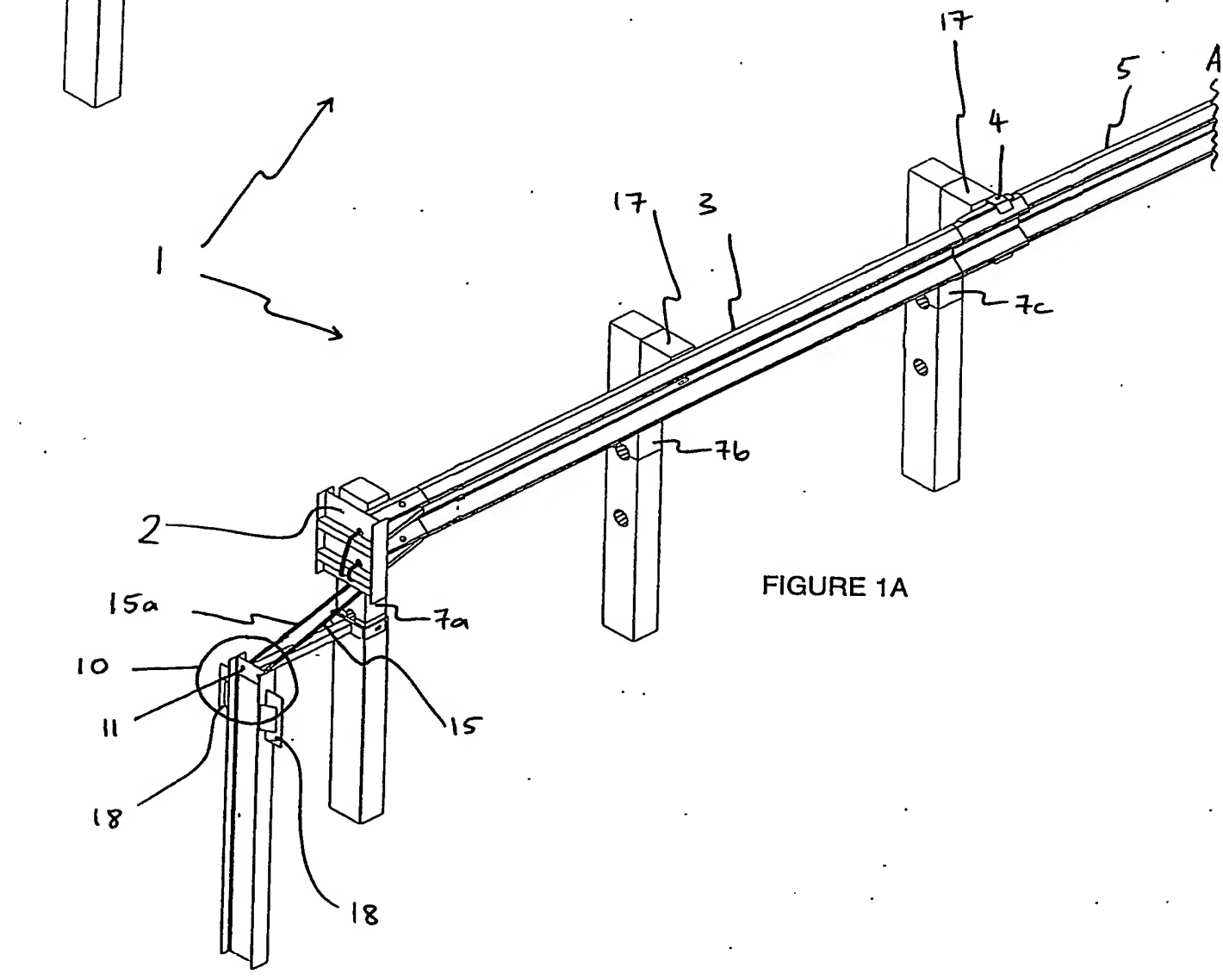


FIGURE 1A

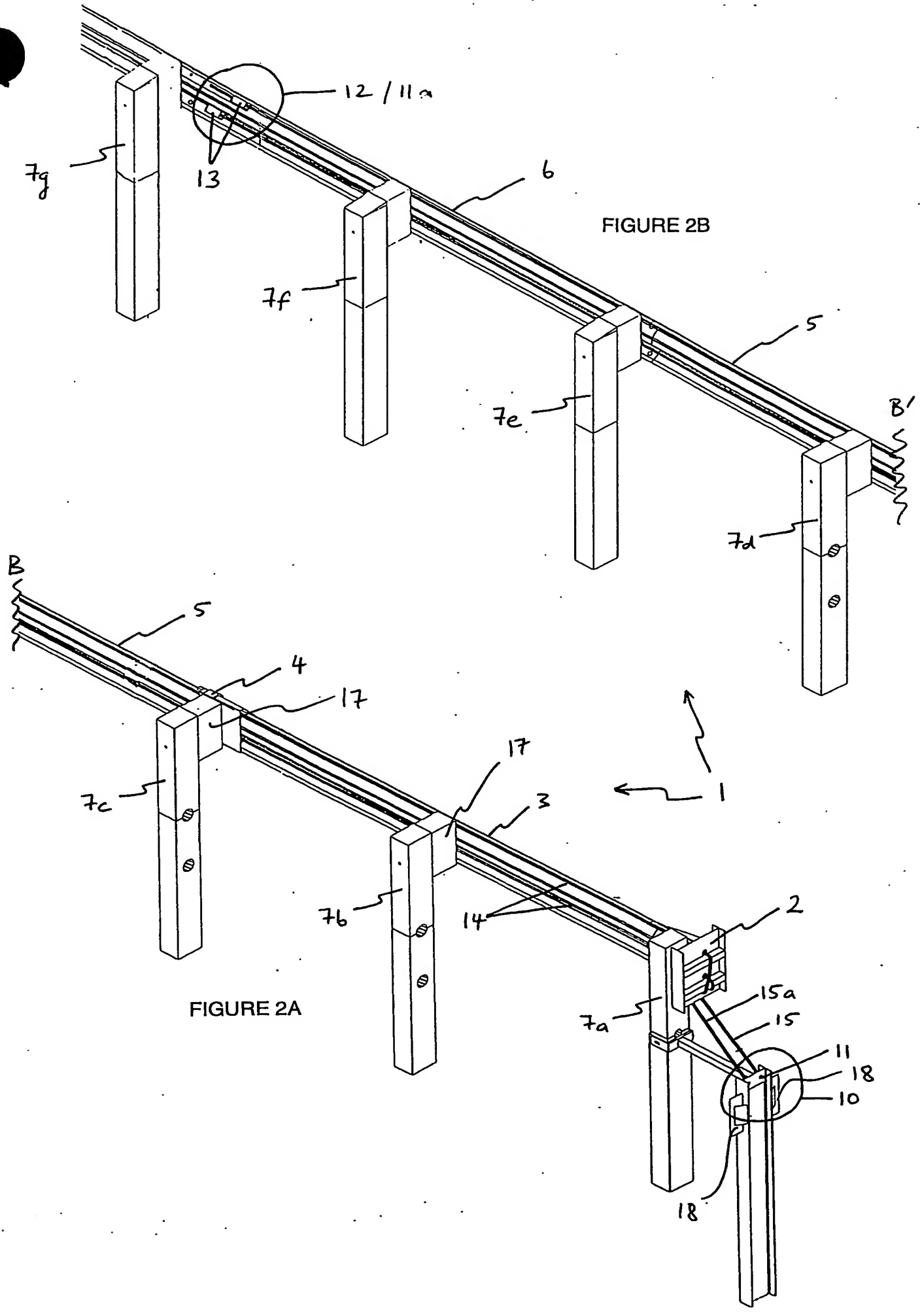


FIGURE 2B

FIGURE 2A